

## CLAIMS

What is claimed is:

- 1        1. An elevated pressure and temperature fluid processing system  
2 comprising:
  - 3            a pressurized fluid delivery system including a process fluid supply  
4 system and pump for supplying a process fluid at a pressure of at least a  
5 process pressure, and a process fluid heater for heating said process fluid;
  - 6            a process chamber with a process chamber heater; and
  - 7            a process discharge collection system;
  - 8            a process chamber inflow valve for connecting said pressurized fluid  
9 delivery system to said process chamber for fluid flow;
  - 10          a process chamber outflow valve for connecting said process  
11 chamber to said collection system for fluid flow;
  - 12          a process chamber bypass valve for connecting said pressurized fluid  
13 delivery system to said process discharge collection system so as to bypass  
14 said process chamber; and
  - 15          a computer control system controlling said pump, said process fluid  
16 heater, said chamber heater, and said valves.
- 17
- 1        2. The system according to claim 1 wherein said pressurized fluid delivery  
2 system comprises a process fluid re-circulation system, and wherein said  
3 pump functions continuously.
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- 1        3. The system according to claim 2 wherein said process fluid re-  
2 circulation system comprises:
  - 3            a first valve whereby said process fluid supply system and pump are  
4 isolated from said first process fluid heater and said chamber when said  
5 first valve is closed;
  - 6            a check valve disposed between said process fluid re-circulation  
7 system and a process fluid source;

8           a temperature control device whereby said process fluid is  
9    maintained in a liquid phase;

10           a re-circulation loop whereby said process fluid in said liquid phase  
11    is directed through said temperature control device and said pump.

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1    4. The system according to claim 1, said process discharge collection  
2    system further comprising a recovery volume connecting to said process  
3    chamber for receiving a rapid discharge of process reagents from said  
4    process chamber, and recovery volume control valves for selecting and de-  
5    selecting said recovery volume from said process discharge collection  
6    system, said recovery volume control valves being controlled by said  
7    computer control system.

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1    5. The system according to claim 1, said chamber heater comprising a  
2    heating subsystem with inflow and outflow lines connecting a source of a  
3    preheated heat transfer medium to at least one heat exchanger in said  
4    process chamber and control valves for controlling the circulation of said  
5    preheated heat transfer medium through said heat exchanger, said control  
6    valves being controlled by said computer control system for achieving a  
7    desired heating effect within said chamber.

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1    6. The system according to claim 1, said process fluid being carbon  
2    dioxide.

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1    7. The system according to claim 1, said process being a supercritical  
2    phase process for cleaning and processing devices chosen from the group of  
3    devices consisting of semiconductor wafers, masks, light emitting diodes,  
4    and disk drive components.

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1    8. The system according to claim 1 further comprising:

2           a pressurized additives delivery system including an additives supply  
3   system and pump for supplying additives at a pressure of at least said  
4   process pressure, and an additives heater for heating said additives to a  
5   pre-process temperature suitable for mixing with said process fluid;

6           a directional valve and mixer disposed between said process fluids  
7   heater, said process chamber, and said additives heater;

8           said additives heater and said directional valve being controlled by  
9   said computer control system;

10          said pressurized fluid delivery system and said pressurized additives  
11   delivery system being connected to said directional valve such that a  
12   computer controlled ratio of process fluids and additives can be admitted  
13   into said mixer and heater at selected respective temperatures.

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1   9. The system according to claim 8 further comprising:

2           a mixture heater;

3           said mixture heater being disposed between said mixer and said  
4   process chamber; and

5           said mixture heater heating said mixture to at least a process  
6   temperature.

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1   10. The system according to claim 8 wherein said pressurized additives  
2   delivery system comprises an additives re-circulation system, and wherein  
3   said pump functions continuously.

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1   11. The system according to claim 10 wherein said additives re-circulation  
2   system comprises:

3           a first valve whereby said additives supply system and pump are  
4   isolated from said additives heater and said mixer when said first valve is  
5   closed;

6           a check valve disposed between said additives re-circulation system  
7 and an additives source;

8           a temperature control device whereby said additives are maintained  
9 at a selected temperature;

10           a re-circulation loop whereby said additives are directed through said  
11 temperature control device and said pump.

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1   12. The system according to claim 3, said process discharge collection  
2 system further comprising at least one separator for separating phases and  
3 constituents from the process discharge.

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1   13. The system according to claim 12, further comprising a return line from  
2 said collection system to said pressurized fluid delivery system.

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1   14. The system according to claim 12, further comprising a return line from  
2 said collection system to said pressurized additives delivery system.

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1   15. The system according to claim 8 wherein said additive heater, said  
2 process chamber heater, and said process fluid heater are each selected  
3 from the group of heaters consisting of heat exchangers and electric  
4 resistance heaters.

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1   16. A system for the supply of elevated pressure and temperature fluid to a  
2 process system, said system comprising:

3           a pressurized fluid delivery system including a process fluid supply  
4 system and pump for supplying a process fluid at a pressure of at least a  
5 process pressure, and a process fluid heater for heating said process fluid  
6 to a process fluid mixing temperature;

7           a pressurized additives delivery system including an additives supply  
8 system and pump for supplying additives at a pressure of at least said

9 process pressure, and an additives heater for heating said additives to a  
10 additive mixing temperature suitable for mixing with said process fluid;  
11 a directional valve, disposed between said process fluids heater, said  
12 additive heater and the process system, said process fluid heater, said  
13 additives heater, said directional valve being controlled by a computer  
14 control system; and

15 said pressurized fluid delivery system and said pressurized additives  
16 delivery system being connected to said directional valve such that a  
17 computer controlled ratio of process fluids and additives can be admitted  
18 through said mixing valve.

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1 17. The system according to claim 16 further comprising a mixer, said  
2 mixer being disposed between said mixing valve and the process system.

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1 18. The system according to claim 17 wherein said mixer is chosen from  
2 the group of mixers consisting of static and dynamic mixers.

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1 19. The system according to claim 17 further comprising:

2 a mixture heater;

3 said mixture heater being disposed between said mixer and the  
4 process system; and

5 said mixture heater heating said mixture to at least a process  
6 temperature.

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1 20. The system according to claim 19 wherein said process temperature  
2 induces a phase change in at least said process fluid from a liquid phase to  
3 a supercritical phase.

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1 21. The system according to claim 17 further comprising a shunt disposed  
2 between said mixer and the process system, for selectively diverting said  
3 process fluid and additives from the process system.

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1 22. The system according to claim 16 wherein said process fluid mixing  
2 temperature is at least equal to a process temperature.

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1 23. The system according to claim 16 wherein said process fluid mixing  
2 temperature induces a phase change in said process fluid from a liquid  
3 phase to a supercritical phase.

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1 24. A method for mixing additives to a process fluid in a high pressure and  
2 temperature fluid processing system comprising the steps:

3        maintaining a supply of process fluid at a pressure of at least a  
4 process pressure in communication via a common conduit with a pressure  
5 vessel;

6        maintaining a supply of additives in a fluid form at a pressure of at  
7 least said process pressure in communication with said pressure vessel via  
8 said common conduit;

9        adjusting the temperature of said supply of process fluid for a first  
10 desired mixing temperature;

11        adjusting the temperature of said supply of additives in fluid form  
12 for a second desired mixing temperature; and

13        admitting respective flows from respective supplies of said process  
14 fluid and said additives at a selected ratio into said common conduit so as  
15 to have a mixture flowing in said common conduit.

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1 25. The method according to claim 24, further comprising adjusting the  
2 temperature of said mixture to a desired process temperature.

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1        26. The method according to claim 24, further comprising the steps:  
2                arranging a bypass valve disposed in said common conduit for  
3        bypassing said pressure vessel,  
4                adjusting said bypass valve so as to direct said mixture into  
5        said pressure vessel when said mixture reaches said desired  
6        process temperature and a homogenous state.